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ON THE FEEDING BEHAVIOR OF FISHES WITH TERMINAL MOUTHS

THE recent article by A. C. Weed entitled "Feeding the Muskalonge"[1] contains this statement: "Swallowing was by a series of gulping movements in which the whole fish seemed to move forward, started and stopped by the pectoral fins." It suggested the recording of the following notes, especially since there seems to be no other specific mention of primary food ingesting movements of this type.

Esox immaculatus Garrard and others of that genus are not alone in the habit that Weed mentions, it apparently being the common method employed by all long snouted forms with a deep terminal gape that are free swimming in habit, unless especially equipt toward other ends. For example, specimens of the pike-like characin, *Ctenolucius beani* (Fowler), have been observed to engulf proportionally rather large *Astyanax* in this manner. Although these observations were made repeatedly in the field, the exact manner in which the jaws were operated could not be determined from the dorsal view, the only one possible. However,

1. Copeia No. 146, Sept. 20, 1925, pp. 69–70.

the grosser aspects were identical, a literal swimming around the food object. This method of "surrounding" food is even more pronounced in forms with snouts longer than those of either *Ctenolucius* or any members of the genus *Esox*. *Lepisosteus osseus* (Linnæus) and *Tylosurus marinus* (Walbaum) show it particularly well, but more especially the latter. The distinct impression is given of the food as being a relatively fixed point in space over which the fish slips, as a tube. The effect is enhanced in cases where the distance that the food travels at each forward movement is relatively great.

The action appears to be due to a slight loosening of the jaw's grip accompanied by a short forward swim, the resistance of the water carrying the food back, relatively, further into the gape. In these forms, as Weed points out for *E. immaculatus*, there is "no indication of an alternate movement of different sets of teeth as there is in a snake." These actions are continued until the food disappears entirely within the oral cavity. In addition to using the pectoral fins in starting, the pelvics are generally brought into play and often flexures of the body as well, expecially in *Tylosurus*. Stopping appears to depend almost entirely on the paired fins, although a slight flexure of any or all of the median fins, as sometimes seen, must have some braking effect. *Lepisosteus platostomus* Rafinesque and *L. tristœchus* (Bloch and Schneider) do not show this action as well as their cogener *L. osseus*, resembling the pikes more in this respect, as the shape of their jaws would suggest.

None of the various short snouted species living in the New York Aquarium have been noted to habitually use this method of inching food inward, generally a single gulp or a bite out of an object constituting the act of bringing the food completely into the mouth, *e. g. Salvelinus fontinalis* (Mitchill). In many forms with large terminal, or nearly terminal, mouths, but with comparatively short snouts, the method of

taking food is peculiarly simple. When the fish's mouth is close to the desired object it is suddenly opened widely, thus causing a current to rush inward and fill the increased oral cavity. The food is carried in on this current and is prevented from emerging again both by the descending teeth and the fact that the current continues in its backward trend, for most of the water passes out through the gill clefts, as in ordinary respiration. Large *Promicrops itaiara* (Lichtenstein), *Lobotes surinamensis* (Bloch) and *Cynoscion regalis* (Bloch and Schneider) show this particularly well. A five foot *Promicrops* can easily engulf a twelve inch *Clupea* in this manner.

The action of food taking in its primary stages, as here outlined, is thus evidently a function of the elongation of the jaws in species with terminal mouths and is based largely on mechanical conditions. In forms with extremely elongate snouts the food proceeds to the oral cavity by a series of steps caused by the water forcing it along as the fish makes slight swimming movements, whereas in short snouted forms the simple act of opening the mouth, because of its corresponding greater capacity, produces an inward current sufficiently strong to carry the food with it, thus obviating such swimming movements.

C. M. Breder, Jr.

New York Aquarium.

A NOTE ON THE BREEDING OF SPADE-FOOT TOADS IN SOUTHERN ARIZONA

After two days of astonishingly rich entomological collecting in one of the canyons of the Santa Rita Mountains, thirty miles south of Tuscon, Arizona, my companion, W. J. Chamberlin of Corvallis, Oregon, and I decided to try a night of desert collecting and, accordingly, we made camp among the mesquite and

choya cacti near the little town of Continental on the evening of July 27th.

Our usual method for capturing moths and other nocturnal insects by means of a gasoline lamp against a cotton sheet proving only moderately successful, we retired fairly early, unmindful of the gathering clouds which had been threatening for several days during the afternoons and evenings. At midnight, however, it began to rain, at first a soft, refreshing drizzle, but shortly after that a heavy, steady down-pour with blinding flashes of lightning and crashing thunder. After an hour, when the storm had somewhat abated we became cognizant of two very distinct and resonant calls coming out of the darkness from different directions in the desert. One was the shrill whistle of a *Bufo* and the other the loud bleating, sounding somewhat like "blah-blah", of a *Scaphiopus*. None of these calls had been heard by us until then during our sojourn in Arizona. Soon after day-break we found several of the newly-formed pools along the highway to Tucson teeming with *Scaphiopus hammondii*, many of them mating and already masses of tangled egg strings attached to submerged weeds and brambles.

Well acquainted with the spade-foots of the Eastern States and in Utah and Nevada, it, nevertheless, is always an important event to the writer to run across these secretive creatures which are hardly ever encountered excepting in pools during their brief breeding season. How they live at other times is still largely a matter of conjecture. But how do they manage to carry on their subterranean existence below the parched floors of Arizona deserts and a still greater wonder, how are they able to preserve and control their sexual fecundities so that they may function at the psychological moment of sufficient rain-fall in a country where this is a question not only of months, but sometimes of years?

GEORGE P. ENGELHARDT

Brooklyn Museum.

ON THE OVIPARITY OF *LACHESIS MUTA* DAUDIN, 1803

R. DITMARS, in his book, "Reptiles of the World," 1910, tab. 85, 1, published a photograph of a female *Lachesis muta* coiled upon a clump of eggs. R. R. Mole, from Port-of-Spain, Trinidad, who took the picture and sent it to Ditmars, stated that those eggs had been laid by the snake herself. Later he (Mole) published a very long and detailed account in the Proceedings of the Zoölogical Society of London with many observations, (P. Z. S., 1924, p. 261). These, however, have been the only remarks that have ever been published on the egg-laying habit of the dreaded Bushmaster.

Now I am able to show that this habit is really widespread, as was to be expected. Recently, having called at Bahia on my return trip to Brazil during the summer of 1924, I found a nice set consisting of 11 beautiful eggs which were laid by a Bushmaster (called Surucucu or Surucutinga in Brazil), at the "Posto" of the Butantan Institute at that city.

The snake which was captured in Marahu, Bahia, by Mr. J. Almeida Sobrinho in December 1921, was kept alone in a comfortable cage in order that she might quietly lay her eggs. She was watched by Prof. Piraja da Silva, director of the mentioned "Posto." The eggs which did not hatch, as seen at present, are pinkish white in color, sub-elliptical in shape and measure about 8 x 4 cms. At present, the snake as well as the eggs is preserved at the Butantan Institute, S. Paulo, Brazil. She is 1 m. 94 long and shows the following scutellation: Lab. 11, Sc. 25, V. 220, C. 45-45.

This finding brings forth one more characteristic to the differentiation of the monotypical genus *Lachesis* Daudin, 1807 (type *muta*) from the genus *Bothrops* Wagler, 1924 which contains all of the other rattle-less Neotropical *Crotalidæ*, its type being *B. atrox* Linné, 1758.

The differences that have heretofore been found between these two genera can be summarized as follows:

	Lachesis DAUDIN 1803	Bothrops WAGLER 1824
Pterygoid teeth	not found beyond the transverso-pterygoid articulation	found beyond
Tracheal lung	absent*	present*
Supra-ocular scales	granular	more or less flat
Dorsal scales	faintly imbricate, tubercularly keeled	more or less strongly imbricate, never tubercularly keeled
Last subcaudal shields	forming 4–5 rough and sharp longitudinal series	smooth and even
Reproductory habit	oviparous	ovo-viviparous

*See G. K. Noble, Snakes That Inflate, in Nat. Hist. 1921, XXI, 2: 170.

AFRANIO DO AMAREL

S. Paulo, May 1925.

SIZE OF YELLOW PERCH

AMONG the problems discussed from time to time in Copeia is that of the varying size of Yellow Perch; why is it that in one pond they are large and in another where the conditions are apparently similar they are small? Is the size due to food and environment or to something in the fish? In this connection the following note may be of interest. Great South Pond, Plymouth, Mass., in a body of clear water about a mile in diameter and maximum depth of 40 feet, the bottom is largely sandy and aquatic vegetation sparse. The pond is the chief source of the water supply of the town. Yellow Perch, locally known as Red Perch, are common but in years past none of any size have been taken, those of even a quarter of a pound weight being rare. In May 1919, the local Committee on Fisheries placed a number of Yellow Perch in this pond, which seemed something like taking coals to Newcastle. However, in 1924 it was reported that perch unusually large for this pond have been taken and this summer, 1925, many perch, weighing from a quarter to nearly three quarters of a pound have been taken. Dr. Rich, of

the Bureau of Fisheries, who kindly examined the scales from two fish weighing about three-eighths of a pound each, reported them as being in their fourth year, which would indicate that the larger were from five to seven years old. The inference is justifiable that these large fish are the descendants of those introduced in 1919, and it would appear that their rapid growth and comparatively large size is due to something inherent in the fishes themselves, since all fish in Great South Pond live under the same conditions.

To renew the discussion of size, it may be said that Cook's and Triangle Ponds, Plymouth, are about half a mile apart; both are rather small, rather shallow ponds with muddy bottoms and abundant aquatic vegetation; the fish are of the same species in each pond. Cook's Pond is noted for large Yellow Perch; fifty years ago perch of a pound weight were not uncommon and to-day, although like all Plymouth Ponds, Cook's is overfished, perch of three quarters of a pound have been caught. Dr. Rich has determined the ages of these to be from seven to nine years. In Triangle Pond no large perch have ever been taken, certainly of the many score I have caught during the last three years not one would weigh a quarter of a pound! "Why is this thus?"

F. A. Lucas

GRAPTEMYS GEOGRAPHICA IN CANADA[1]

"*Graptemys geographica*. Range: Mississippi valley north to Iowa, northern Illinois, southern Michigan, east to Pennsylvania and New York, south shore of Lake Ontario and Lake George and Lake Champlain." Check List of North American Amphibians and Reptiles.

The herpetological collection of the National Museum

1. Published with the permission of the Acting Director of the National Museum of Canada, Ottawa.

of Canada, Ottawa, Ontario, contains specimens of *G. geographica* which extend the range to the north shore of Lake Ontario, and northward to the Ottawa river, which defines the southern boundary of the province of Quebec.

In September, 1922, my young friend George Glass, brought me a specimen collected at Norway Bay, Quebec, and on July 29, 1924, with the assistance of my young friend, Whitten Young, I collected ten specimens, most of them being first observed sunning themselves on partly submerged boulders.

Norway Bay is a two miles wide expansion of the Ottawa River, and is located about forty miles due west of Ottawa. The bay, indenting the Quebec shore, contains several rocky islands, and is bounded by a broad, sandy beach. *Chelydra serpentina* and *Chrysemys m. marginata* are also abundant.

During the summer of 1924, Mr. R. Owen Meriman and Mr. J. Roland Brown sent in several specimens of *G. geographica*, *C. serpentina*, and *C. m. marginata*, collected in Hamilton harbour, at the western end of Lake Ontario. The largest example of *G. geographica* has a carapace measuring 9½ inches in length. Mr. Merriman has the following to say of a specimen taken on July 21: "One was collected on a sandy, grassy bank in Oakland, about one hundred yards from the shore and fifty feet above the water level. This bank is a favorite place for Painted Turtles to deposit their eggs; and this was probably the reason for this turtle being away from the water."

In July, 1924, an example of *G. geographica*, with a carapace 9½ inches in length and containing fourteen eggs, was received from Guelph, Ontario.

In the Canadian Field-Naturalist, May 1925, p. 93, E. B. Shelley Logier, records the finding of a young specimen of *G. geographica* at Point Pelee, Ontario.

CLYDE L. PATCH

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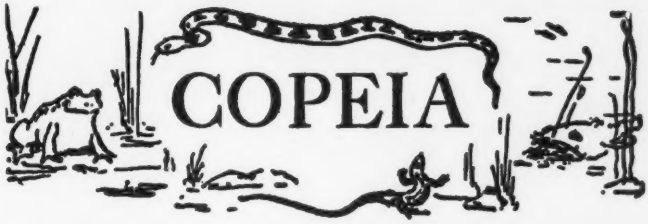

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INDEX 1925

Abramis crysolencas, p. 23.
acanthias, Acanthorhinus, p. 18.
acanthias, Squalus, p. 43.
Achirus fasciatus, p. 44.
Acipenser brevirost , p. 1.
Acipenser sturio, p. 3.
Acris crepitans, p.
Acris gryllus, p. 15, 58, 62, 66.
adamanteus, Crotalus, p. 40.
adspursus, Tautogolabrus, p. 1.
aesculapius, Alepisaurus, p. 74.
aeneus, Myoxocephalus, p. 52, 54, 55.
aestivus, Opheodrys, p. 27, 59, 66.
affnis, Gambusia, p. 16.
agalma, Lampropeltis, p. 48.
agassizi, Raja, p. 39.
Agkistrodon mokasen, p. 60, 63.
albilabris, Leptodactylus, p. 77.
Alepisaurus aesculapius, p. 74.
Alepisaurus altivelis, p. 75.
Alepisaurus borealis, p. 74, 75.
Alepisaurus ferox, p. 74.
Alepisaurus serra, p. 74, 75.
Aleposomus guntheri, p. 75.
alleganiensis, Cryptobranchus, p. 9, 10.
allisoni, Germo, p. 22.
aloha, Rooseveltia, p. 39.
Alpharaia, p. 37.
Alsophis portoricensis, p. 79.
altivelis, Alepisaurus, p. 75.
Alutera schoepfii, p. 46.
amarus, Rhodeus, p. 20, 33.
Ambloplites rupestris, p. 35.
Amblyraja, p. 38.
Ambystoma maculatum, p. 79.
Ambystoma opacum, p. 14, 58.
Ameiurus nebulosus, p. 24.
Ameiva exul, p. 78.
Ameiva wetmorei, p. 78.
americana, Morone, p. 42.
americanus, Ammodytes, p. 45.
americanus, Hemitripterus, p. 45.
americanus, Esox, p. 16, 50, 51.
americanus, Pseudopleuronectes, p. 44.
Ammocoetes borealis, p. 36.
Ammocoetes unicolor, p. 35.
Ammodytes americanus, p. 45.
amoenus, Notropis photogenis, p. 24.
Amphiardis inornatus, p. 48.
Amphignathodontidae, p. 8.
Amphisbaena bakeri, p. 78.
analostanus, Notropis whipplii, p. 23
Anchoviella purpurea, p. 28.
Anchoviinae, p. 28.
Anolis carolinensis, p. 14.
Anolis cristatellus, p. 77.
Anolis krugi, p. 78.
Anolis poncensis, p. 78.
Anolis pulchellus, p. 78.
Anolis stratulus, p. 77.
Anthinae, p. 40.
anthonyi, Diadophius, p. 48.
Aphredoderus sayanus, p. 16.
apiensis, Stolephorus, p. 28.
Apsilus zonatus, p. 39.
Arizona elegans occidentalis, p. 48.
arnyi, Diaophus punctatus, p. 27.
Astroscopus guttatus, p. 45.
Astyanax, p. 89.
atherinoides, Clupea, p. 31.
atlanticus, Megalops, p. 43.
atlanticus, Tarpon, p. 3, 4.
atromaculatus, Semotilus, p. 15, 23.
atronasus, Rhinichthys, p. 24.
atrox, Bothrops, p. 93.
Atsatt, S. R., p. 72.
auriculata, Desmognathus fusca, p. 15.
auriculatus, Eleutherodactylus, p. 77.
auritus, Lepomis, p. 24.
Bairdiella chrysura, p. 42, 45.
bakeri, Amphisbaena, p. 78.
Balistes carolinensis, p. 1, 46.
batis, Raia, p. 38.
beani, Ctenolucius, p. 89.
Betaraia, p. 37.
bigutatus, Stethochaetus, p. 29.
biscutatus, Thamnophis ordinoides, p. 48.
Bishop, Sherman C., p. 12.
bislineata, Eurycea, p. 14, 58.
bislineata, Eurycea bislineata, p. 11.
blanda, p. 37.
boelama, Clupea, p. 30.
Boleichthys fusiforme, p. 16.
Boleosoma olmstedi, p. 16.
Boleosdma nigrum olmstedi, p. 24.
bonasus, Rhinoptera, p. 43.
borealis, Alepisaurus, p. 74, 75.
borealis, Ammocoetes, p. 36.
borealis, Sphyraena, p. 2.
Bothrops atrox, p. 93.
brachyura, Raia, p. 38.
branchialis, p. 76.
Breder, C. M., Jr., p. 56, 91.
brevirostrum Aciyenserf p. 1.

brevirostrum, Engraulis, p. 31.
brevis, Tridens, p. 83, 84, 86.
brevis, Tridentopsis, p. 86.
Brevoortia tyrannus, p. 43.
brighami, Serranus, p. 39.
Brimley, C. S., p. 16.
Bufo, p. 91.
Bufo fowleri, p. 58, 62, 66.
Bufo marinus, p. 76.
Bufo woodhousii, p. 26.
bullaris, Semotilus, p. 23.
Callisaurus, p. 71.
canadus, Rachycentron, p. 1, 4.
canis, Mustelus, p. 41, 43.
Caranx chrysos, p. 4.
Carcharhinus, p. 18, 19.
Carcharhinus commersonii, p. 21.
carcharhinus limbatus, p. 3, 4.
Carcharhinus milberti, p. 2.
Carcharhinus obscurus, p. 21.
Carcharias, p. 19, 20.
Carcharias lamia, p. 18.
carcharias, Squalus, p. 17, 18, 19.
carcharias, Squalus (Carcharhinus), p. 18.
Carcharias taurus, p. 18, 19. 41.
Carcharodon rondeleti, p. 19.
Carcharodon verus, p. 19.
Caretta caretta, p. 61, 67.
carlsmithi, Rhyacanthias, p. 39.
carolina, Terrapene, p. 60, 64.
carolinensis, Anolis, p. 14.
carolinensis, Balistes, p. 1, 46.
carolinensis, Desmognathus ochrophaeus, p 12
carolinus, Trachinotus, p. 44.
Carphophis amoena helenae, p. 47.
cataractae, Rhinichthys, p. 24.
catesbeiana, Rana, p. 59, 62, 66.
catesbiana, Rana, p. 15.
Catostomus commersonnii, p. 23.
Catostomus ingricans, p. 23.
Centropristis striatus, p. 42, 44.
Cephaleutherus, p. 38.
cephalus, Mugil, p. 4.
Chaetodipterus faber, p. 4, 45.
Chelydra serpentina, p. 27, 60, 64, 66, 69.
chilensis, Sarda, p. 22.
Chilomeniscus ephippicus, p. 48.
Chilomycterus schoepfi, p. 4, 46.
Chologaster cornutus, p. 15.
Chrysemys m. marginata, p. 96.
Chrysemys picta, p. 14, 60, 64, 66.
chrysops, Roccus, p. 24.
chrysops, Stenotomus, p. 44.
chrysopterus, Orthopristes, p. 1, 44.
chrysos, Caranx, p. 4.
chrysura, Bairdiella, p. 42, 45.
cinereus, Plethodon, p. 10, 58, 62.
circularis, Raia, p. 37.
clamitans, Rana, p. 15, 59, 62, 66.
Clarias depresus, p. 12.
clavata, Raia, p. 37.
Clemmys guttata, p. 14, 60, 64, 66.
Clemmys insculpta, p. 64.
Clench, W. J., p. 40.
Clupea atherinoides, p. 31.
Clupea boelama, p. 30.
Clupea enchrasicolus, p. 32.
Clupea, harengus, p. 43.
Clupea setirostris, p. 29.
Clupea telara, p. 29.
Clupeidae, p. 28.
Clarias malaris, p. 13.
Carcharhinus milberti, p. 21.
Cnemidophorus sexlineatus, p. 26.
Coilia hamiltoni, p. 28.
Coilia quadragesimalis, p. 28.
Coiliinae, p. 28.
collaris, Crotaphytus collaris, p. 26.
Coluber, p. 47.
Coluber constrictor, p. 59, 63, 66.
Coluber constrictor flaviventris, p. 27.
commersonianus, Stolephorus, p. 30.
commersonnii, p. 21, 18, 22.
commersonii, Carcharhinus, p. 21.
commersonnii, Catostomus, p. 23.
commersonii, Squalis, p. 17.
concentrica, Malaclemys centrata, p. 60, 64.
concolor, Ichthyomyzon, p. 34.
confinis, Elaphe obsoleta, p. 27.
Conger conger, p. 43.
conger, Conger, p. 43.
consobrinus, Sceloporus, p. 26.
constrictor, Coluber, p. 59, 63, 66.
contortrix, Heterodon, p. 27, 59, 63, 66.
Copelandellus quiescens, p. 16.
coriacea, Dermochelys, p. 61.
cornutus, Chologaster, p. 15.
cornutus, Notropis, p. 24.
couchii, Thamnophis ordinoides, p. 7.
Crawford, D. R., p. 75.
Creaser, Charles W., p. 36.
crepitans, Acris, p. 15.
Crimmins, M. L., p. 7.
cristatellus, Anolis, p. 77
crocodilus, Engraulis, p. 29.
cromis, Pogonias, p. 45.
Crotalidae, p. 93.
Crotalus adamanteus, p. 40.
Crotalus atrox elegans, p. 48.
Crotalus goldmani, p. 48.
Crotalus horridus, p. 63.
Crotalus oreganus, p. 7.
Crotaphytus collaris collaris, p. 26.
crucifer, Hyla, p. 59, 62.
Cryptobranchus alleganiensis, p. 9, 10.
crysolencas, Abramis, p. 23.
crysoleucas, Notemigonus, p. 15.
Ctenolucius beani, p. 89.
Clupea, p. 91.
curema, Mugil, p. 44.
Cyclopterus lumpus, p. 45.
Cycloramphus, p. 8.
Cynoscion nebulosus, p. 45.
Cynoscion regalis, p. 42, 45, 91.
Danforth, Stuart T., p. 79.
danielsi, Gyrimophilus, p. 10.
Dasybatus, p. 38.
Dasyatis say, p. 43.
dekayi, Storeria, p. 27, 60, 63.
Deltaraia, p. 38.
Dence, W. A., p. 33.
dentatus, Paralichthys, p. 41, 43.
depressus, Clarias, p. 12.
Dermochelys coriacea, p. 61.
Desmognathus fuscus, p. 11, 14, 58, 62, 65.
Desmognathus fusca auriculata, p. 15.
Desmognathus ochrophaeus carolinensis, p. 12.
Desmognathus ochrophaeus ochrophaeus, p. 11.
Desmognathus phoca, p. 12.
Desmognathus quadra-maculatus, p. 12.
Diadophis amabilis modestus, p. 47.
Diadophis anthonyi, p. 48.
Diadophis punctatus, p. 63, 66.
Diaophus punctatus arnyi, p. 27.
Dipturus, p. 38.
Amaral, Afranio do, p. 94.
dolomieu, Micropterus, p. 24.
dubius, Grypiscus, p. 8.
edentulus, Engraulis, p. 31.
eglanteria, Raja, p. 41, 43.
Elaphe obsoleta, p. 59, 63.
Elaphe obsoleta confinis, p. 27.

Elaphe obsoleta lindheimeri, p. 48.
Elaphe rosaliae, p. 88.
Elaphe subocularis, p. 87.
Elassoma zonatum, p. 16.
elegans, Crotalus atrox, p. 48.
Eleutherodactylus auriculatus, p. 77.
eleutherodactylus, Grypiscus, p. 8.
enchrasicolus, Clupea, p. 32
Engelhardt, George P., p. 92.
Engraulinae, p. 28.
Engraulis brevirostrum, p. 31.
Engraulis crocodilus, p. 29.
Engraulis edentulus, p. 31.
Engraulis grossidens, p. 30.
Engraulis macrolepidotus, p. 31.
Engraulis perfasciatus, p. 31.
Engraulites remifer, p. 31.
Enneacanthus gloriosus, p. 16.
Enneacanthus obesus, p. 16.
ephippicus, Chilomeniscus, p. 48.
Epsilonraia, p. 38.
Erimyzon sucetta, p. 15.
Erwin, Richard P., p. 7.
erythrogaster, Natrix sipedon, p. 48.
erythrophthalmus, Scardinius, p. 21.
Esox americanus, p. 16, 50, 51.
Esox americanus vermiculatus, p. 70.
Exos immaculatus, p. 69, 89, 90.
Esox lucius, p. 35, 50, 70.
Esox niger, p. 51.
Esox phaleratus, p. 50.
Esox reticulatus, p. 51.
Esox tridecemlineatus, p. 24, 50.
Etaraia, p. 38.
Eulamia lamia, p. 20.
Eulamia plumbea, p. 42.
Eurycea bislineata, p. 14, 58.
Eurycea bislineata bislineata, p. 11.
Eurycea bislineata wilderae, p. 11.
Eurycea longicauda, p. 11, 62.
Eurycea rubra, p. 58, 62, 65.
Eurypharynx richardi, p. 75.
Eusalpa, p. 75.
evermanni, Stolephorus, p. 28.
Exoglossum maxillingua, p. 24.
exul, Ameiva, p. 78.
faber, Chaetodipterus, p. 4, 45.
fasciatus, Achirus, p. 44.
fasciatus, Plestiodon, p. 26, 59, 63, 66.
ferox, Alepisaurus, p. 74
flagellum, Masticophis flagellum, p. 27.
flaviventris, Coluber constrictor, p. 27.
flarigularis, Masticophis flagellum, p. 48.
fluviatilis, Petromyzon, p. 76.
fontinalis, Salvelinus, p. 90.
Force, Edith R., p. 27.
fossor, Ichthyomyzon, p. 35.
Fowler, Henry W., p. 24, 39, 40, 42, 61, 64, 67, 76.
fowleri, Bufo, p. 58, 62, 66.
frenatus, Masticophis flagellum, p. 47.
fullonica, Raia, p. 37.
fundulus, p. 21.
Fundulus heteroclitus, p. 81, 83.
Fundulus notti, p. 16.
Fundulus rathbuni, p. 16.
fuscus, Desmognathus, p. 11, 14, 58, 62, 65.
fusiforme, Boleichthys, p. 16.
Galeorhinus galeus, p. 18.
galeus, Galeorhinus, p. 18.
Gambusia affnis, p. 16.
Gammaraia, p. 37.
Gempylus serpens, p. 22.
geographica, Graptemys, p. 95, 96.
Germo allisoni, p. 22.
Germomacropterus, p. 22.
Gerrhonotus, p. 72.
getulus, Lampropeltis, p. 60, 63.
gibbosus, Lepomis, p. 16.
gibbosus, Pomotis, p. 24.
gloriosus, Enncacanthus, p. 16.
glutinosus, Plethodon, p. 10, 14, 62.
goldmani, Crotalus, p. 48.
grahamii, Natrix, p. 27.
Graptemys geographica, p. 95, 96.
Green, Harold T., p. 32.
groenlandicus, Myoxocephalus, p. 56.
grossidens, Engraulis, p. 30.
Gyrinophilus porphyriticus, p. 32.
gryllus, Acris, p. 15, 58, 60, 66.
Grypiscus dubius, p. 8.
Grypiscus eleutherodactylus, p. 8.
Grypiscus pinderi, p. 8.
Grypiscus umbrinus, p. 8.
guntheri, Aleposomus, p. 75.
guttata, Clemmys, p. 60, 66.
guttatus, Astroscopus, p. 45.
guttata, Clemmys, p. 14, 64.
Gyrinophilus danielsi, p. 10.
Gyrinophilus porphyriticus, p. 11.
gyrinus, Schilbeodes, p. 15.
hamiltoni, Coilia, p. 28.
hamiltoni, Thrissa, p. 30.
hammondi, Scaphiopus, p. 92.
harengus, Clupea, p. 43.
helenae, Carphophis amoena, p. 47.
Hemitripterus americanus, p. 45.
henshawi, Xantusia, p. 71.
herrerae, Lampropeltis, p. 48.
heteroclitus, Fundulus, p. 81, 83.
Heterodon contortrix, p. 27, 59, 63, 66.
Hieroptera, p. 37.
Hippocampus hudsonius, p. 44.
hispidus, Monacanthus, p. 46.
holbrooki, Lampropeltis getulus, p. 27.
horridus, Crotalus, p. 63.
hudsonius, Hippocampus, p. 44.
Hybopsis kentuckiensis, p. 24.
Hyla crucifer, p. 59, 62.
Hyla versicolor, p. 59, 62.
Hypsiglena, p. 47.
Hypsiglena ochrorhynchus ochrorhynchus, p. 7.
Hypsiglena ochrorhynchus texana, p. 48.
Ichthyomyzon concolor, p. 34.
Ichthyomyzon fossor, p. 35.
Ichthyomyzon unicolor, p. 34.
Iliodiscus semipalmatus, p. 8.
immaculatus, Esox, p. 69, 89, 90.
ingricans, Catostomus, p. 23.
inornata, p. 38.
inornatus, Amphiardis, p. 48.
insculpta, Clemmys, p. 64.
insignis, Schilbeodes, p. 15, 24.
Iotaria, p. 38.
itaiara, Promicrops, p. 91.
Jordan, David Starr, p. 20, 32, 39.
Jordanites, p. 75.
kentuckiensis, Hybopsis, p. 24.
Kinosternon odoratum, p. 60, 63.
Kinosternon subrubrum, p. 60, 64, 66.
krugi, Anolis, p. 78.
Lachesis muta, p. 93.
Laeviraja, p. 38.
laevigatus, Lagocephalus, p. 1.
Lagocephalus laevigatus, p. 1.
lamia, Carcharias, p. 18.
lamia, Eulamia, p. 20.
Lampropeltis agalma, p. 48.
Lampropeltis getulus, p. 60, 63.
Lampropeltis getulus holbrooki, p. 27.
Lampropeltis herrerae, p. 48.
Lampropeltis triangulum, p. 60, 63, 66.
Leimadphis stahli, p. 78.

Leiostomus xanthurus, p. 42, 45.
Lepisosteus osseus, p. 90.
Lepisosteus platostomus, p. 90.
Lepisosteus tristoechus, p. 90.
Lepomis auritus, p. 24.
Lepomis gibbosus, p. 16.
Leptecheneis naucrates, p. 45.
Leptodactylus albilabris, p. 77.
lepturus, Trichiurus, p. 44.
Leucoraja, p. 38.
limbatus, Carcharhinus, p. 3, 4.
lindheimeri, Elaphe obsoleta, p. 48.
lineatum, Tropidoclonion, p. 27.
lineatus, Roccus, p. 44.
lintea, p. 38.
Liopeltis vernalis, p. 63.
Lobotes surinamensis, p. 1, 91.
lodingi, Pituophis, p. 48.
longicauda, Eurycea, p. 11, 62.
Lophius piscatorius, p. 2, 46.
Lophopsetta maculata, p. 43.
Lucas, F. A., p. 95.
lucius, Esox, p. 35, 50, 70.
lumpus, Cyclopterus, p. 45.
Mabee, W. B., p. 16.
macrolepidotus, Engraulis, p. 31.
macrolepis, Sphaerodactylus, p. 77.
maculata, p. 37.
maculata, Lophopsetta, p. 43.
maculatum, Ambystoma, p. 79.
maculatus, Sphoeroides, p. 42, 46.
maculosus, Necturus, p. 14.
maderensis, p. 37.
Malaclemys centrata concentrica, p. 60, 64.
Malacorhina, p. 39.
malaris, Clarias, p. 13.
marginata, Chrysemys m., p. 96.
marginata, Raia, p. 38.
marginatus, Stereochilus, p. 14.
marina, Strongylura, p. 41, 43.
marinus, Bufo, p. 76.
marinus, Petromyson, p. 4, 35.
marinus, Tylosurus, p. 90.
Masticophis flagellum flagellum, p. 27.
Masticophis flagellum flavigularis, p. 48.
Masticophis flagellum frenatus, p. 47.
maxillingua, Exoglossum, p. 24.
mediocris, Pomolobus, p. 4, 43.
megalops atlanticus, p. 43.
melanops, Tridens, p. 83, 84, 86.
Menidia menidia notata, p. 44.
Menticirrhus saxatilis, p. 4, 42, 45.
microcellata, p. 37.
Microgadus, p. 76.
Microgathus tomcod, p. 43.
Microgmathus, p. 76.
Micropterus dolomieu, p. 24.
Micropogon undulatus, p. 42, 45.
milberti, Carcharhinus, p. 2, 21.
minaletus, Raja, p. 38.
mira, Raja, p. 39.
mitchilli, Myoxocephalus, p. 52, 54, 55.
modestus, Diadophis amabilis, p. 47.
mokasen, Agkistrodon, p. 60, 63.
Monacanthus hispidus, p. 46.
Morone americana, p. 42.
Mugil cephalus, p. 4.
Mugil curema, p. 44.
Muraena rostrata, p. 23, 41, 43.
murrayi, Raia, p. 38.
Mustelus canis, p. 41, 43.
muta, Lachesis, p. 93.
Myers, G. S., p. 13, 21, 86.
Myoxocephalus aeneus, p. 52, 54, 55.
Myoxocephalus groenlandicus, p. 56.
Myoxocephalus mitchilli, p. 52, 54, 55.
Myoxocephalus octodecimspinosus, p. 45.
Natrix fasciata pictiventris, p. 8.
Natrix grahamii, p. 27.
Natrix septemvittata, p. 27, 60.
Natrix sipedon, p. 60, 63, 66.
Natrix sipedon erythrogaster, p. 48.
Natrix transversa, p. 27.
naucrates, Leptecheneis, p. 45.
nebulosus, Ameiurus, p. 24.
nebulosus, Cynoscion, p. 45.
Necturus maculosus, p. 9, 10, 14.
Necturus punctatus, p. 14.
Nichols, J. T., p. 23.
nidrosiensis, p. 38.
niger, Esox, p. 51.
notata, Menidia menidia, p. 44.
Notemigonus crysoleucas, p. 15.
Notophthalmus viridescens, p. 58, 62, 65.
Notropis cornutus, p. 24.
Notropis photogenis amoenus, p. 24.
Notropis whipplii analostanus, p. 23.
notti, Fundulus, p. 16.
obesus, Enneacanthus, p. 16.
obsoleta, Elaphe, p. 59, 63.
obscurus, Carcharhinus, p. 21.
occidentalis, Arizona elegans, p. 48.
ocellatus, Sciaenops, p. 42, 45.
ochrophaeus, Desmognathus ochrophaeus, p. 11.
ochrorhynchus, Hypsiglena ochrorhynchus, p. 7.
octodecimspinosus, Myoxocephalus, p. 45.
octonemus, Polydactylus, p. 3, 4.
Odontaspis, p. 19, 20.
olmstedi, Boleosoma, p. 16.
olmstedi, Boleosuma nigrum, p. 24.
odoratum, Kinosternon, p. 60, 63.
onitis, Tautoga, p. 45.
opacum, Ambystoma, p. 14, 58.
Opheodrys aestivus, p. 27, 59, 66.
Ophisaurus ventralis, p. 26.
Opsanus tau, p. 42, 45.
oreganus, Crotalus, p. 7.
Orthopristes chrysopterus, p. 1, 44.
osseus, Lepisosteus, p. 90.
palustris, Pseudemys, p. 79.
palustris, Rana, p. 59, 62, 66.
Paralichthys dentatus, p. 41, 43.
Parker, G. H., p. 83.
Patch, Clyde L., p. 96.
pearsoni, Tridentopsis, p. 84, 86.
perfasciatus, Engraulis, p. 31.
Petromison, p. 76.
Petromyzon fluviatilis, p. 76.
Petromyzon marinus, p. 4, 35, 76.
phaleratus, Esox, p. 50.
phoca, Desmognathus, p. 12.
Physis regius, p. 43.
picta, Chrysemys, p. 14, 60, 64, 66.
pictiventris, Natrix fasciata, p. 8.
pinderi, Grypiscus, p. 8.
pipiens, Rana, p. 59, 62, 66.
piscatorius, Lophius, p. 2, 46.
Pituophis lodingi, p. 48.
Pituophis sayi sayi, p. 27.
pianori, p. 76.
Platana, Raia, p. 38.
Platopterus, p. 38.
platostomus, Lepisosteus, p. 90.
Plestiodon, p. 72.
Plestiodon fasciatus, p. 26, 59, 62, 66.
Plethodon cinereus, p. 10, 58, 62.
Plethodon glutinosus, p. 10, 14, 62.
plumbea, Eulamia, p. 42.
Pogonias cromis, p. 45.
Polydactylus octonemus, p. 3, 4.
Polydon spathula, p. 67.
Pomatomus saltatrix, p. 41, 44.

Pomolobus mediocris, p. 4, 43.
Pomotis gibbosus, p. 24.
Pomoxis sparoides, p. 24.
poncensis, Anolis, p. 78.
porphyriticus, Gyrinophilus, p. 11, 32.
portoricensis, Alsophis, p. 79.
Prionotus evolans strigatus, p. 45.
Pristipomatidae, p. 39.
Promicrops itaiara, p. 91.
Propoma roseum, p. 39, 40.
Propterygia, p. 38.
proximus, Thamnophis, p. 27.
Pseudacris triseriatus, p. 62.
Pseudemys palustris, p. 79.
Pseudemys rubriventris, p. 61, 64, 67.
Pseudemys scripta, p. 14.
Pseudopleuronectes americanus, p. 44.
pulchellus, Anolis, p. 78.
punctatus, Diadophis, p. 63, 66.
punctatus, Necturus, p. 14.
purpurea, Anchoviella, p. 28.
pygmaea, Umbra, p. 16.
quadragesimalis, Coilia, p. 28.
quadra-maculatus, Desmognathus,
quiescens, Copelandellus, p. 16.
Rachycentron canadus, p. 1, 4.
radiata, Raia, p. 38.
radula, Raia, p. 38.
Raia batis, p. 38.
Raia brachyura, p. 38.
Raia circularis, p. 37.
Raia clarata, p. 37.
Raia eatoni, p. 38.
Raia fullonica, p. 37.
Raia marginata, p. 38.
Raia murrayi, p. 38.
Raia platana, p. 38.
Raia radiata, p. 38.
Raia radula, p. 38.
Raia rhina, p. 37.
Raia undulata, p. 38.
Raja agassizi, p. 29.
Raja batis, p. 38.
Raja eglanteria, p. 41, 43.
Raja minaletus, p. 38.
Raja mira, p. 39.
Raja oxyohynchus, p. 39.
Rana catesbeiana, p. 59, 62, 66.
Rana catesbiana, p. 15.
Rana clamitans, p. 15, 59, 62, 66.
Rana palustris, p. 59, 62, 66.
Rana pipiens, p. 59, 62, 66.
Rana sphenocephala, p. 15.
Rana sylvatica, p. 59, 63.
rathbuni, Fundulus, p. 16.
regalis, Cynoscion, p. 91, 42, 45.
regius, Phycis, p. 43.
remifer, Engraulites, p. 31.
reticulatus, Esox, p. 51.
rhina, Raia, p. 37.
Rhinichthys atronasus, p. 24.
Rhinichthys cataractae, p. 24.
Rhinoptera boncsus, p. 43.
Rhodeus amarus, p. 20, 33.
Rhyacanthias carlsmithi, p. 39.
richardi, Eurypharynx, p. 75.
richardi, Typhlops, p. 78.
Roccus chrysops, p. 24.
Roccus lineatos, p. 44.
rondeleti, Carcharodon, p. 19.
Rooseveltia aloha, p. 39.
rosalia, Elaphe, p. 88.
roseum, Propoma, p. 39, 40.
rostrata, Muraena, p. 23, 41, 43.
Rouelina, p. 75.
rubra, Eurycea, p. 58, 62, 65.
rubriventris, Pseudemys, p. 61, 64, 67.
rupestris, Ambloplites, p. 35.
Ruthven, Alexander G., p. 47.
salpa, Sparus, p. 75.
saltatrix, Pomatomus, p. 41, 44.
Salvelinus fontinalis, p. 90.
Sarpa, p. 75.
Sarda chilensis, p. 22.
Sarda sarda, p. 22.
Sarda velox, p. 22.
sauritus, Thamnophis, p. 63.
say, Dasyatis, p. 43.
saxatilis, Menticirrhus, p. 4, 42, 45.
sayanus, Aphredoderus, p. 16.
sayi, Pituophis sayi, p. 27.
Scaphiopus hammondii, p. 92.
Scardinius erythrophthalmus, p. 21.
Sceloporus, p. 71.
Sceloporus consobrinus, p. 26.
Sceloporus undulatus, p. 59, 63, 66.
Schilbeodes gyrinus, p. 15.
Schilbeodes insignis, p. 15, 24.
Schmidt, Karl P., p. 88.
schoepfi, Chilomycterus, p. 4, 46.
schoepfii, Alutera, p. 46.
Sciaenops ocellatus, p. 42, 45.
Scomber scombrus, p. 44.
scombrus, Scomber, p. 44.
scripta, Pseudemys, p. 14.
Selene vomer, p. 44.
semiannulata, Sonora, p. 6.
semipalmatus, Iliodiscus, p. 8.
Semotilus atromaculatus, p. 15, 23.
Semotilus bullaris, p. 23.
septemvittata, Natrix, p. 27, 60.
Seriola zonata, p. 44.
serpens, Gempylus, p. 22.
serpentina, Chelydra, p. 27, 60, 64, 66, 96.
serra, Alepisaurus, p. 74, 75.
Serranidae, p. 40.
Serranus brighami, p. 39.
setipinnis, Vomer, p. 4.
setirostris, Clupea, p. 29.
sexlineatus, Cnemidophorus, p. 26.
sipedon, Natrix, p. 60, 63, 66.
sirtalis, Thamnophis, p. 60, 63.
Sonora semiannulata, p. 6.
sparoides, Pomoxis, p. 24.
Sparus salpa, p. 75.
spathula, Polyodon, p. 67.
Sphaerodactylus macrolepis, p. 77.
sphenocephala, Rana, p. 15.
Sphoecroides maculatus, p. 42, 46.
Sphyraena, borealis, p. 2.
Sphyrna zygaena, p. 41, 45.
spinidens, Xenengraulis, p. 29.
Squalus acanthias, p. 43.
Squalus (Carcharhinus) carcharias, p. 18.
Squalus carcharias L., p. 17, 18, 19.
Squalus commersonii, p. 17.
stahli, Leimadophis, p. 78.
Steele, Alvin, p. 32.
Stenotomus chrysops, p. 44.
Stereochilus marginatus, p. 14.
Stethochaetus biguttatus, p. 29.
Stolephorinae, p. 28.
Stolephorus apiensis, p. 28.
Stolephorus commersonianus, p. 30.
Stolephorus evermanni, p. 28.
Storeria dekayi, p. 27, 60, 63.
stratulus, Anolis, p. 77.
striatus, Centropristis, p. 42, 44.
strigatus, Prionotus evolans, p. 45.
Strongylura marina, p. 41, 43.
sturio, Acipenser, p. 43.
subocularis, Elaphe, p. 87.
subrubrum, Kinosternon, p. 60, 64, 66.
sucetta, Erimyzon, p. 15.

surinamensis, Lobotes, p. 1, 91.
sylvatica, Rana, p. 59, 63.
Tarpon atlanticus, p. 3, 4.
tau, Opsanus, p. 42, 45.
taurus, Carcharias, p. 18, 41, 42.
Tautoga onitis, p. 45.
tautogolabrus, Adspursus, p. 1.
telara, Clupea, p. 29.
Terrapene carolina, p. 60, 64.
Terrapene carolina triunguis, p. 27.
texana, Hypsiglena ochrorhynchus, p. 48.
Thamnophis ordinoides biscutatus, p. 48
Thamnophis ordinoides couchii, p. 7.
Thamnophis proximus, p. 27.
Thamnophis sauritus, p. 63.
Thamnophis sirtalis, p. 60, 63.
Thetaraia, p. 38.
Thrissa hamiltoni, p. 30.
Thunnus thynnus, p. 44.
thynnus, Thunnus, p. 44.
tomcod, Microgathus, p. 43.
Tompkins, M. I., p. 80.
Trachinotus carolinus, p. 44.
transversa, Natrix, p. 27.
triangulum, Lampropeltis, p. 60, 63, 66.
Trichiurus lepturus, p. 44.
tridecemlineatus, Esox, p. 24, 50, 51.
Tridens brevis, p. 83, 84, 86.
Tridens melanops, p. 83, 84, 86.
Tridentopsis brevis, p. 86.
Tridentopsis pearsoni, p. 84, 86.
Trimorphodon vilkinsonii, p. 7.
triseriatus, Pseudacris, p. 62.
tristoechus, Lepisosteus, p. 90.
Triturus viridescens, p. 15.
triunguis, Terrapene carolina, p. 27.
Tropidoclonion lineatum, p. 27.
Tylosurus marinus, p. 90.
Typhlops richardii, p. 78.
tyrannus, Brevoortia, p. 43.
Umbra pygmaea, p. 16.
umbrinus, Grypiscus, p. 8.
undulata, Raia, p. 38.
undulatus, Micropogon, p. 42, 45.
undulatus, Sceloporus, p. 59, 62, 66.
unicolor, Ammocoetes, p. 35.
unicolor, Ichthyomyzon, p. 34.
Uraptera, p. 39.
Uta, p. 71.
valeriae, Virginia, p. 60, 66.
velox, Sarda, p. 22.
ventralis, Ophisaurus, p. 26.
vermiculatus, Esox americanus, p. 70.
vernalis, Liopeltis, p. 63.
versicolor, Hyla, p. 59, 62.
verus, Carcharodon, p. 19.
vigilis, Xantusia, p. 72.
vilkinsonii, Trimorphodon, p. 7.
Virginia valeriae, p. 60, 66.
viridescens, Triturus, p. 15.
viridescens, Notophthalmus, p. 58, 62, 65.
vomer, Selene, p. 44.
Vomer setipinnis, p. 4.
Weed, Alfred C., p. 51, 68, 70.
wetmorei, Ameiva, p. 78.
wilderae, Eurycea bislineata, p. 11.
xanthurus, Leiostomus, p. 42, 45.
Xantusia henshawi, p. 71.
Xantusia vigilis, p. 72.
Xenengraulis spinidens, p. 29.
Zetaraia, p. 38.
zonata, Seriola, p. 44.
zonatum, Elassoma, p. 16.
zonatus, Apsilus, p. 39.
zygaena, Spyrna, p. 41, 43.
woodhousii, Bufo, p. 26.